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e) illuminating said article by a beam of the same wavelength as said coherent beams so that light therefrom passes through or reflects off said objective and through an imaging lens to diffract through or off said hologram to reconstruct the original reference beam but with article information retained, to correct for defects in said objective and to provide an accurate image in a recording medium or for viewing.

37. A method for image correction in a microscope comprising,

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84
- a) passing a laser beam through a beam splitter to form separate coherent beams 1 & 2,
 - b) directing beam 1 through a first array of pinholes to illuminate an objective and define an object beam,
 - c) directing beam 2 through a second array of pinhole to a collimating lens to define a reference beam and then into interference with said object beam in a recording medium to define a hologram,
 - d) removing said first array of pinholes and replacing said pinhole array with an article to be viewed and
 - e) illuminating said article by a beam of the same wavelength as said laser beam so that light therefrom passes through or reflects off said objective and through an imaging lens to diffract through or off said hologram to reconstruct the original reference beam but with article information retained, to correct for defects in said objective and to provide an accurate image in a recording medium or for viewing.
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REMARKS

Claims 1 – 8, 12 – 26 & 29 – 39 are in the present application. Four of these claims have been amended as indicated above for clarity and no new matter has been added.

Again the objection to the drawings under 37 C.F.R. 1.83(a) as not showing every feature of the claimed invention is again respectfully traversed. As already stated, such microscopes are

already shown in Applicant's original drawings, e.g. Figures 4, 6, 12, and 14, for clear examples thereof for those skilled in the art.

Also the invention is said to include a microscope, e.g. on pages 4, 5, 6, and 7 and thus there is believed ample disclosure of the microscope embodiment of the present invention.

In addition the inventor is providing herewith a Declaration under 37 CFR 1.132 attesting to the fact that Figures 4, 6, 12 and 14 do in fact show Applicant's inventive holographic microscope to those skilled in the art.

Accordingly, no corrected drawings are needed and this objection is believed met.

As to paragraph 6 and 7 of the Office Action, repeating "new matter" objections as to claims 1, 2, 19 and 21, such objections have already been answered in Applicant's previous amendment dated 4 June 2002, on page 3, omitting the last two lines thereof. Such page 3 is attached hereto as Exhibit B for review by the Examiner.

The Office Action states in paragraph 7 that the present specification only gives support for a holographic image corrector to be employed in a microscope but does not give support for the corrector to comprise a microscope. This is curious because on page 5, lines 13 and 14 it is stated that the system of the invention can be employed, e.g., as a microscope.

Thus the specification clearly notes that the optical system of the invention can be employed as a microscope and can be said to comprise a microscope in the claims as well.

As stated previously, for the scope of the phrase "holographic image corrector" in the specification, one need only review Applicant's Summary of the Invention, on pages 3 and 4, which defines the scope of an image corrector, which has components a), b), c) and d) and which includes the hologram (or optical plate) in paragraph c) thereof. That is, the hologram is just an element of Applicant's defined image corrector. Again it is requested that the Examiner pay heed to Applicant's clearly spelled out disclosure and not overlook same.

as a
microscope
is
support
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microscope
Image corrector
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The Office Action rejection of claims 1, 2 – 8, 12 – 14, 15 – 17, 18, 21 – 26, 29 – 31, 32 – 36 and 37 as indefinite under 35 U.S.C. 112, first paragraph, as not being enabling, is respectfully traversed. The Office Action makes the point that once a distorted wavefront is recorded as a hologram, the object must be illuminated in the backwards sense such that conjugated reconstructing light is shined from the opposite direction through the hologram first then through the distorting medium to obtain an undistorted wavefront.

Thus the Office Action points out the conventional wisdom of image correction in the prior art. Surprisingly however, Applicant has invented a new method that goes counter to the conventional wisdom and per his claims 1 et seq, e.g., paragraph f) illuminates the article in the forward sense, contrary to the Hariharan Article and instead of adding distortion upon distortion, as asserted in the above Office Action, actually achieves image correction which only highlights the novelty of the present claims.

To support the above image correction by article illumination passing back through the hologram, in the forward sense, to provide a corrected article image, the Examiner is referred to the inventor's Declaration under 37 CFR 1.132 and his attached Paper (excerpt) which discloses Applicant's unexpected principle of forward sense illumination.

The Office Action expresses doubt as to the utility or workability of claim 36 and opines that illuminating a hologram with a reference beam will just reconstruct the original object beam and will not form an additional interference pattern. Surprisingly however, Applicant's method of claim 36 does produce an interference pattern of light and dark fringes as attested to by Applicant's Declaration under 37 C.F.R. 1.132.

Applicant agrees with the Examiner that this is an unexpected result, which highlights the novelty of such claim.

Also the Office Action states that the specification fails to teach how such additional interference patterns can be formed per claim 36. However a considerable disclosure of the method of claim 36 is found on page 14, first full paragraph and illustrated in Figure 15 hereof, which is believed sufficient disclosure for those skilled in the art.

The Office Action rejections of most of 1–31, as set forth in paragraphs 10 and 11 of the above Office Action, are respectfully traversed. The invention is believed fully disclosed and enabled as discussed at length above.

As to the objection to claims 2, 19 & 21 asking how a holographic image corrector is capable of comprising a microscope since it is only a single optical plate, this objection is not understood. That is, Applicant has referred the Examiner previously and again in this response, to the Summary of the Invention on pages 3 and 4; notes that the invention can provide for a corrected optical system such as a corrected microscope on page 4 and on page 5 notes that the optical system of the invention can be employed as a microscope. What more can Applicant do for those skilled in the art? Applicant is baffled as to why the Examiner keeps limiting his disclosure to a single optical plate, which is just the hologram, which is listed in Applicant's Summary of the Invention as just part of the invention.

Also looking at Applicant's drawings, e.g., Figure 4, how can one say that the optical system that is shown is limited to a single plate, the hologram 41 and ignore the rest of the optical elements?

Thus it is believed that Applicant's disclosure is sufficiently enabling to those skilled in the art and amply disclose a holographic image corrector comprising a microscope and not just a single optical plate.

As for, “providing an accurate image in a recording medium” as recited in claims 18 and 37, such recording medium is not the hologram recited in such claims but a camera for recording such accurate image.

The Office Action rejection of claims 12, 18 & 37 as indefinite under 35 U.S.C. 112, second paragraph, is respectfully traversed. Objection is made to the phrase “said pinhole is replaced by a first spatial filter” in claim 12.

Also the phrase “the article” in claims 18 & 37 is objected to as lacking proper antecedent basis. Both of the above concerns have been addressed by amending claims 12, 18, and 37 as noted above and this rejection is believed met.

Further the Examiner is thanked for repeating rejections set forth in previous Office Actions, which considerably assist the response to a 10 page Office Action.

The Office Action rejection of claims 1, 2, 8, 12 – 14, 15 – 17, 18, 19, 20, 21 – 26, 29 – 31, 32 – 36, 37, 38 and 39 as obvious under 35 U.S.C. 103(a) over the Schock et al Article, in view of the Friedl patent (‘466), is respectfully traversed.

It is agreed that Schock forms a hologram per his Figure 6, but there the similarity ends. The Office Action then combines the telescope of Friedl with the plexi-glass cylinder of Schock, in order to arrive at Applicant’s claimed holographic image corrector. That is, as previously stated, the Office Action would make too many changes to Schock such as replacing a plexi-glass cylinder with a lens from Friedl, reversing the direction of the beam of Schock’s Figure 7 and placing an object to be viewed in his plexi-glass cylinder, which would hinder fluid flow and destroy Schock’s intended function of monitoring fluid flow, all in an attempt to reconstruct Applicant’s holographically corrected microscope as claimed. No motivation is seen for destroying the function of the Schock cylinder by making the changes noted above, absent

Applicant's disclosure. This appears to be a case of hindsight reconstruction that does not establish obviousness, In re Civitello, 144 USPQ 10.

That is the Office Action is attempting to combine the telescope of Friedl with the flow cylinder of Schock in attempt to suggest the microscope of the present invention as claimed. Thus the Schock and Friedl references are believed so disparate as to be not properly combinable.

A further problem with this combination is, per Schock's Figure 7, when one looks down the converging beams there shown, such beams converge to a point which makes it difficult to see anything but a tiny bright point, e.g., on an article, as this is a system for photo reducing or micro machining and not for microscopic viewing.

The Examiner's rejection of claim 1 has to do with not giving patentable weight to "microscope" because it is in the preamble of such claim and while this point is debatable, claim 1 has been amended to the style of claims 2 et seq to limit the issues.

As for claims 2, 21 and 38 wherein "a holographic image corrector comprises a microscope" it is said that the intended use does not differentiate the claimed apparatus from a prior art apparatus. However there is no prior art microscope cited here. What we have is a combined plexi-glass cylinder and telescope. Two different structures are cited against a microscope, a third different structure. Thus Applicant's claims 2, 21 and 38 do not rely on how they are intended to be used but because they define a different structure from the two prior art references despite the attempt to combine such disparate references.

As for the method claims, claims 15, 18, 32, 37 and 39 a new use is given patentable weight over the prior art. Here we have a telescope use (Freidl) and monitoring flow in a cylindrical pipe (Schock), neither of which suggests the use of a hologram for making a low cost microscope. And no art has been cited which suggests the novel use of Applicant's above five method claims.

As for the recitation of concave mirrors in place of lenses in Applicant's claims, no prior art is cited that employs such a structure as Applicant's holographic image corrector including a microscope.

As for Applicant's claimed array of pinholes of claims 21 and later claims, the Office Action admits that no reference has been found that teaches such array and falls back on "an obvious matter of design choice", since a single pinhole is known. This suggests to Applicant that without a cited reference to the contrary, such pinhole array is novel and should be recognized as such.

That is, as previously noted, Applicant's claims 21 et seq are directed to a holographic microscope which employs an array of pinholes, which array has not been seen in the prior art in correcting lenses and certainly not in a microscope, per Applicant's claims.

The Office Action would dismiss this distinction by stating that an array of pinholes is an obvious manner or design choice but cites not a single reference to support this generalization.

Referring to the Examiner's response to arguments on page 10:

As to paragraph 17, the Office Actions avers that applicant's arguments are based on a wrong principle of image correction and thus his disclosure is not enabling which response seems to overlook another principle; that one can obtain a patent on a structure or method even if it is not clear how the method works scientifically.

The Examiner further avers that the idea of using a hologram to correct an aberrated wave front is known in the art. Agreed. But to go beyond a hologram in a flow pipe or in a telescope, to provide a new method or structure, i.e., a holographically corrected microscope, is seen as a novel structure or method, as limited by its claims. As for the pinhole array, a previous Office Action stated that the specification fails to teach the criticality of having a pin-hole array that would overcome any problem of using a single pinhole plate. However an example of such

criticality as previously noted, is found in claim 36, where a reference beam is added to the reconstruction of a hologram (e.g. in Figure 15), that interferes with the hologram image so as to produce a fringed pattern thereon to permit extracting height information for a contour map of the object viewed. It happens that this contour map is only possible with an array of pinholes.

Also the use of an array of pinholes to correct an objective in a microscope and to have a broad field of view is a structural feature of claims 21 et seq that is nowhere seen in the prior art. Thus, as the Office Action has not pointed out a reference that remotely suggests such claims, they are believed to have considerable novelty.

As for the method claim 36, again, it is believed highly novel in its use of two interference patterns, to provide a contour plot of an image. And no art has been cited which remotely suggests the novelty of this claim.

In view of the foregoing, the claims of record, as amended, are believed distinguished over the applied art and in condition for allowance. Early notice of allowance is requested.

In accordance with Section 714.01 of the M.P.E.P., the following information is presented in the event that a call may be deemed desirable by the Examiner: Thomas C. Stover, (781) 377-3779.

Respectfully submitted,



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Registration No 22,531

Marked-up version of claims to show changes made to above clean version.

1. (Five Times Amended) A holographic image corrector comprising, a
microscope which has,

- a) an optical system having an objective,
- b) at least one pinhole mounted before said objective,
- c) means for recording the characteristics of said objective by sending a first laser beam through said pinhole and through said objective or reflecting said beam therefrom to form an object beam,
- d) means for intersecting said object beam with a reference laser beam in a recording medium to form a hologram of said objective, said laser beams being coherent,
- e) means to replace said pinhole with an article and
- f) means to illuminate said article with a beam of the same wavelength as said laser beams so that light therefrom passes through or reflects off said objective and diffracts through or off said hologram and provides a corrected image of said article.

12. (Twice Amended) The image corrector of claim 2 wherein said pinhole is replaced by a first spatial filter mounted before said objective and [said] a second spatial filter is mounted in the path of the reference beam before it interferes with said object beam and means to replace said first spatial filter with an article in the manner of step e) of claim 2.

18. (Four Times Amended) A method for image correction in a microscope comprising,

- a) passing a laser beam through a beam splitter to form separate coherent beams 1 & 2,
- b) directing beam 1 through a first pinhole to illuminate an objective and define an object beam,
- c) directing beam 2 through a second pinhole to a collimating lens to define a reference beam and then into interference with said object beam in a recording medium to define a hologram,

d) removing said first pinhole before said objective and replacing said pinhole with [the] an article to be viewed and

e) illuminating said article by a beam of the same wavelength as said coherent beams so that light therefrom passes through or reflects off said objective and through an imaging lens to diffract through or off said hologram to reconstruct the original reference beam but with article information retained, to correct for defects in said objective and to provide an accurate image in a recording medium or for viewing.

37. (Four Times Amended) A method for image correction in a microscope comprising,

a) passing a laser beam through a beam splitter to form separate coherent beams 1 & 2,
b) directing beam 1 through a first array of pinholes to illuminate an objective and define an object beam,

c) directing beam 2 through a second array of pinholes to a collimating lens to define a reference beam and then into interference with said object beam in a recording medium to define a hologram,

d) removing said first array of pinholes and replacing said pinhole array with [the] an article to be viewed and

e) illuminating said article by a beam of the same wavelength as said laser beam so that light therefrom passes through or reflects off said objective and through an imaging lens to diffract through or off said hologram to reconstruct the original reference beam but with article information retained, to correct for defects in said objective and to provide an accurate image in a recording medium or for viewing.

Exhibit A

The Office Action rejection of Applicant's claims 1, 2, 19 and 21 as amended by Applicant's amendment, dated 19 October 2001, causing such claims to read "a holographic image corrector comprising a microscope...", under 35 USC 132, as new matter, is respectfully traversed.

The Office Action states that the specification "herein" only gives support to a holographic image corrector to be employed in a microscope and not to comprise a microscope. The Office Action goes on to say that the specification discloses that the holographic corrector is a single optical plate that is impossible to comprise a microscope which is a complicated optical system. However the Office Action may be referring to an amendment "for a microscope" to certain claims such as claim 1, which was withdrawn, as shown in Applicant's most recent amendment of 19 October 2001.

For the scope of the phrase "holographic image corrector", in the specification, one need only review Applicant's summary of the invention on pages 3 and 4, which defines the scope of an image corrector which has components a), b), c) and d) and which includes the hologram (or optical plate) in paragraph c) thereof. That is, the hologram is just an element of Applicant's defined image corrector.

The next paragraph on page 4 states that the image corrector of the invention provides for aberration correction of an optical system such a microscope. That is, such image corrector can define a microscope, such as shown in Applicant's Figures 4, 6, 12 and 14. Clearly, there is no way that Applicant's claimed invention as described and shown in the drawings, can be limited to a mere holographic element.

The Office Action rejection of claims 12, 16, 18, 33 and 37 as indefinite under 35 U.S.C. 112, second paragraph, is respectfully traversed.